THE BROWN-SPOT OF CORN WITH SUGGESTIONS FOR ITS CONTROL

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THE PURPOSE of this bulletin is to familiarize the farmer with the appearance, distribution, nature, and economic importance of the brown-spot of corn and to offer certain helpful suggestions for its control.

The leaf blades of diseased plants have a rusty appearance which differs from that of a true rust. On the leaf sheath and stalk diseased areas are larger than on the blades and are darker in color (see figs. 1 and 2). Diseased plants turn yellow and may finally break over at the lower nodes.

The disease is present throughout a large part of the corn-growing section east of the Rocky Mountains, but is most prevalent and destructive in the South Atlantic and Gulf Coast States.

Damage caused by the disease may amount to 10 per cent of the crop, but the average loss is considerably lower.

High temperature in combination with high humidity favors the development of the disease. For this reason the damage is greater in the South, where high temperatures prevail throughout the summer and the rainfall is rather heavy.

The disease is caused by a minute fungous parasite, which enters through the epidermis of the plant, invades the tissues, and produces numerous spores in the cells of the corn plant. These spores germinate the following season to produce a new crop of the fungus.

Careful field sanitation, crop rotation, and seed selection aid in controlling the disease.

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REGIONAL DISTRIBUTION OF THE DISEASE.

CONSIDERABLE DAMAGE is caused to the corn crop of the South by the brown-spot (Physoderma) which was discovered in India in 1910 and in the State of Illinois in 1911. The disease has been found over a large part of the corn-producing sections of the United States since that time. It is abundant throughout the South Atlantic and Gulf States and is doing considerable damage in that section.

DESCRIPTION OF THE DISEASE.

The disease is characterized by the appearance of brown spots on the leaf, leaf sheath, and stalk (figs. 1 and 2), and in rare cases it has been seen on the outer husks of the ears. The spots usually are more abundant on the lower half of the plant. From a distance, diseased plants have a rusty appearance, especially if the blades are diseased. Diseased leaf sheaths and stalks are identified by darker spots, which may be almost black in color.

DISTRIBUTION AND PREVALENCE OF THE DISEASE.

Brown-spot is a serious disease of corn occurring abundantly throughout the southeastern part of the United States and known to occur as far west as central Texas. It is found as far north as South Dakota and southern Minnesota and eastward to central New Jersey. It is most prevalent in the South Atlantic and Gulf Coast States and in the lower Mississippi Valley, where there is a high degree of humidity with a relatively high temperature. These factors favor the development of the disease.

DAMAGE CAUSED.

Damage caused by the disease is usually local, owing to the fact that its development is closely connected with weather conditions, which vary in different localities and in any one locality in different seasons. The most pronounced losses have been caused along the South Atlantic and Gulf Coast States and in the lower Mississippi Valley. In the lowlands of North Carolina and South Carolina and in the Gulf and Delta sections of Mississippi frequent reports of as much as 5 per cent loss have been received. In some cases the damage was estimated at 6 to 10 per cent of the crop. The writer visited a few fields in the eastern part of South Carolina where the damage was perhaps as much as 10 per cent. Fields so badly injured were seldom found, however. These estimates were based entirely on grain loss. The fodder is often injured very badly. Besides the areas mentioned above, where the damage is more or less general, are low wet areas throughout the South and as far north as southern Illinois, where damage has been caused by the disease.

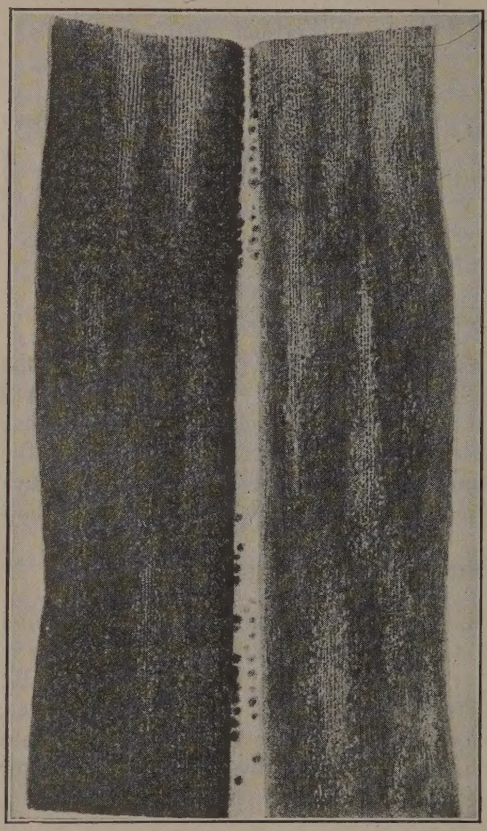

FIG. 1.—Corn leaf showing brown-spot on blade and midrib.

SYMPTOMS.

The disease in its first appearance on the leaf blades (fig. 1) resembles the early stages of the true corn rust. The latter, however, is characterized by an open pustule and has an entirely different

cause. Rust is confined largely to the leaf blades and causes little damage to the corn crop where it is present.

Brown-spot first appears as slightly bleached or yellowish spots which become darker within a few days (fig. 1). This darkening continues until the spots are brown to reddish brown with a somewhat lighter margin. They are very small (one-twenty-fifth of an inch in diameter), but may be so numerous as to give the blade a rusty appearance. For this reason the disease is often considered a true rust by those who are not familiar with its nature. This rusty appearance is not uncommonly seen in bands across the leaf blades. On the midrib of the leaf blade (fig. 1) and on the leaf sheath (fig. 2) the spots are considerably larger than on the thin parts of the blades (fig. 1). Often a single spot will measure one-fourth of an inch in diameter. These spots are irregular in shape and sometimes may be almost square in outline. In the early stages of development they appear as dark-green areas, somewhat darker than the normal tissue surrounding them. After a few days they become dark brown in the center. This change in color spreads until the entire spot is dark or chocolate brown. These diseased areas are often so numerous as to run together and cause the entire sheath to become brown and decayed. Sometimes the entire leaf is killed before the plant is mature. The disease is usually more abundant on the parts of the sheath which are beneath the overlapping parts where the moisture is held.

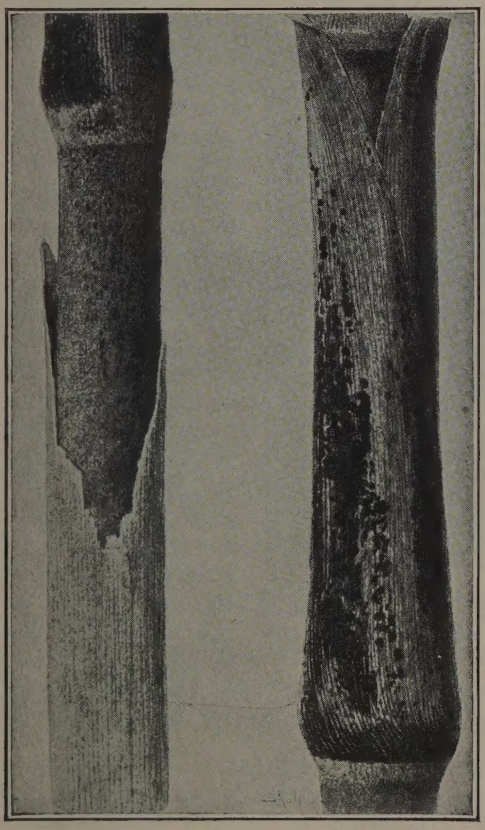

FIG. 2.—Cornstalk and sheath showing brown-spot.

The brown-spot disease is often accompanied by a red color of the sheath and midrib, especially the latter, which may almost entirely hide the brown color. After the plants begin to mature the epidermis (skin) over the spots becomes loose and they appear as brown blisters. These blisters are easily broken when dry and a brown spore dust is liberated. The tissues in the invaded areas are so completely destroyed as to leave only a shredded mass of loose fibers.

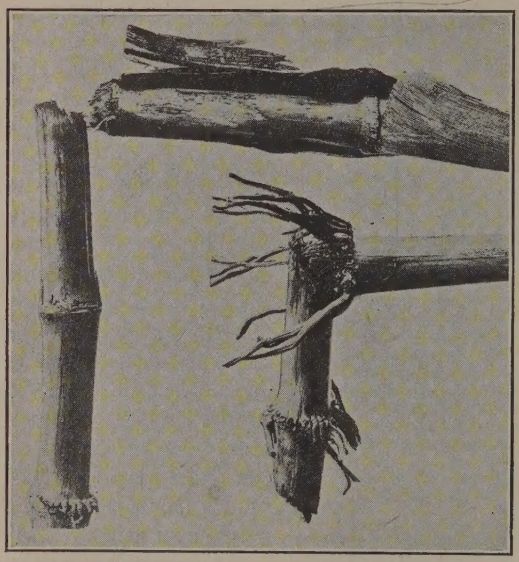

FIG. 3.—Badly diseased cornstalks broken over at the infected and weakened lower joints. These are the effects of the disease where it is the most destructive. (Photographed by Prof. J. M. Beal.)

On the stalks (fig. 2) the spots are very much like those on the sheath (fig. 2) and midrib (fig. 1). They usually are more numerous at the nodes and just below the nodes where free water is held by the sheath. The stalks often are completely girdled at the nodes and are easily broken by winds (fig. 3). In the South the disease is responsible for considerable lodging of corn in the early stages of maturity. The plants usually break at the lower nodes, where the disease is worst. The pith of the broken stalks often is brown and decayed. Considerable damage may be caused by the breaking of plants in this way.

FACTORS INFLUENCING THE DEVELOPMENT OF THE DISEASE.

A high temperature with a moist atmosphere favors the development of the disease. If these conditions occur before the corn plants are more than half grown the disease may do considerable damage. The following facts have been learned regarding these weather conditions:

(1) Serious injury has been confined largely to the South, where the summer temperature is continuously high, and to localities in which there has been considerable rainfall during the early growth of the corn plants. Plants may become diseased in the later stages of growth, but the damage is not then

likely to be great. The warm summer showers, which may occur daily for a week or more, furnish ideal conditions for the development of the disease.

(2) Where seasons are dry the disease is more pronounced on corn growing near the water or on low, wet land where the atmosphere is moist. Under these conditions the foliage of the plants is less subject to drying by winds, and the necessary water for the development of the disease is retained.

(3) Where the early corn season is dry and the late season wet, the disease is more severe on late corn. When the early season is wet and the later period dry, however, early corn is most seriously injured, provided the temperatures are favorable for the development of the fungus.

(4) Apparently the more vigorous plants in certain cases are the most severely attacked. These plants, however, will not continue to look vigorous after the disease has had time to develop. The fact that these vigorous plants are capable of shielding the free water which is held inside the sheath and around the growing point, or bud, from the drying effects of the wind and sun offers more favorable conditions for attacks by the fungus and no doubt accounts for the greater percentage of infection on plants of this type. In low, wet fields small plants are injured the same as large ones. This greater injury to large, vigorous plants was more noticeable in dry territory.

(5) The disease was found on the Blue Ridge Mountains in North Carolina at an altitude of about 3,000 feet, where it is claimed that the summer nights are always cool. In 1917 corn foliage at this point was killed by frost on September 11. Very little of the disease was found, however, at this altitude, even on wet land. The low temperature, no doubt, is the limiting factor in its development. The disease must have a temperature not lower than 70° F. in order to develop at all, and it develops much more readily at temperatures ranging from 80° to 86° F. This probably accounts for the lack of serious injury to the corn crop farther north.

(6) The rare occurrence or absence of the disease farther west may be explained by the semiarid conditions which exist there, where a combination of moisture and temperature suitable for the development of the disease is seldom realized.

CROPS DISEASED.

The disease occurs on all varieties of corn (maize) and on teosinte, a near relative of the corn plant. It is possible that the fungus was introduced from Mexico or Central America with teosinte seed.

CAUSE OF THE DISEASE.

Brown-spot is caused by a minute fungous parasite. This parasite produces spores (fig. 4, *a*) in abundance within the cells of the corn plant. Like the seeds of higher plants, such as wheat, oats, and corn, these spores germinate to produce a new crop of the parasitic fungus that causes brown-spot. These spores are so small that a single one can not be seen with the naked eye. When grouped together in large numbers they appear as a brown mass. They live over winter on the old corn plants or in the soil and are carried by wind, water, insects, and other agencies, and perhaps on the seed corn, and are deposited in the buds of the young corn plants the

following spring. When the weather becomes warm and the early summer showers begin, these spores germinate (fig. 4, *b* to *f*) and produce a large number of very small zoospores (fig. 4, *g*), or swimming spores, which swim around in the water for an hour or more and then come to rest on the surface of the corn plant. These small swimming spores, after settling on the surface of the plant, germi-

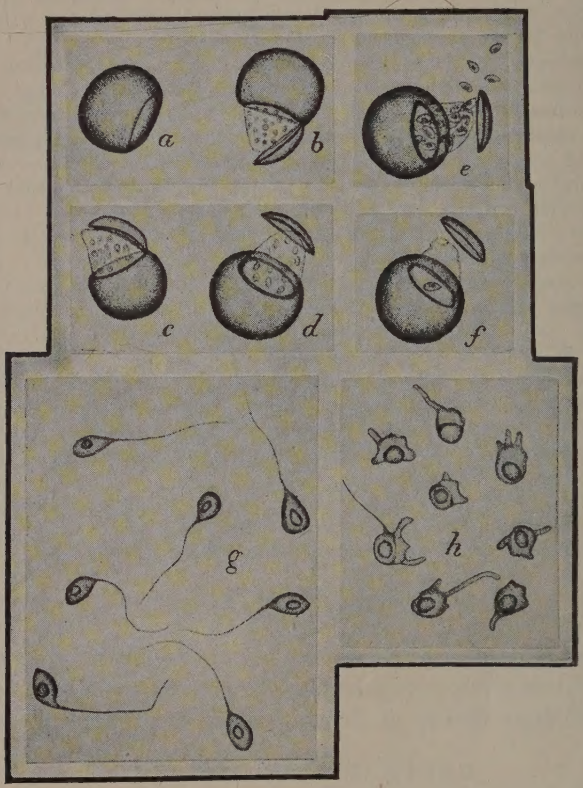

FIG. 4.—Two kinds of spores of brown-spot: *a* to *f*, Spores producing zoospores; *g*, zoospores; *h*, germinating zoospores.

nate by sending out fine, threadlike fibers (fig. 4, *h*) which penetrate the epidermis of the plant and grow into the cells beneath, thus causing the disease. After a few days the larger brown spores are produced in abundance within the invaded cells of the plant. This new crop of spores serves to carry the fungus over winter again. Spores have been found to live two years on old plants, both above and below the soil surface.

CONTROL MEASURES.

(1) Cut the diseased plants as fine as possible with a stalk cutter and turn under deep enough so that they will not be disturbed by ordinary cultivation the following season. This eliminates a large part of the spore material for that year. If possible this material should not be plowed up for at least two years, as the spores live at least that long in the soil.

(2) Where the corn is used for silage or stover the plants should be cut early and as near the ground as possible, in order that a large part of the spores of the fungus may be removed. Barnyard manure containing these and other diseased corn products should not be used as fertilizer on land to be planted to corn and should not be put on land where the disease has not been known to occur previously.

(3) Crop rotation has a tendency to reduce the amount of injury caused by the disease. The most severe cases known have been on land where corn has been grown continuously for a number of years. In a system of rotation the cornfield should be located as far as possible from the area where corn was grown the previous year, as the spores are wind blown and a change of only a short distance would make little difference for this reason. The longer the period between corn crops in the rotation the better the results are likely to be.

(4) There are indications of the disease being started in certain localities from spores carried on the seed corn. It is hardly probable that there is any extensive distribution in this manner, owing to the fact that the spores carried on the seed would in all probability be buried with the seed and not have a chance to cause any trouble that season. No fungicide has been found that will penetrate the thick spore walls and kill the spores. In order to obtain seed corn free from spores, pick ears from disease-free plants or from plants as nearly disease free as possible. Gather the ears without husking and husk after they have been carried to some place where spores will not be blown on them after the husks are removed. This precaution should be taken especially when shipping seed corn to disease-free territory.

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